

# An Introduction to Lightning for Fire Investigators

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TENNESSEE **UT**

# GOALS AND OBJECTIVES

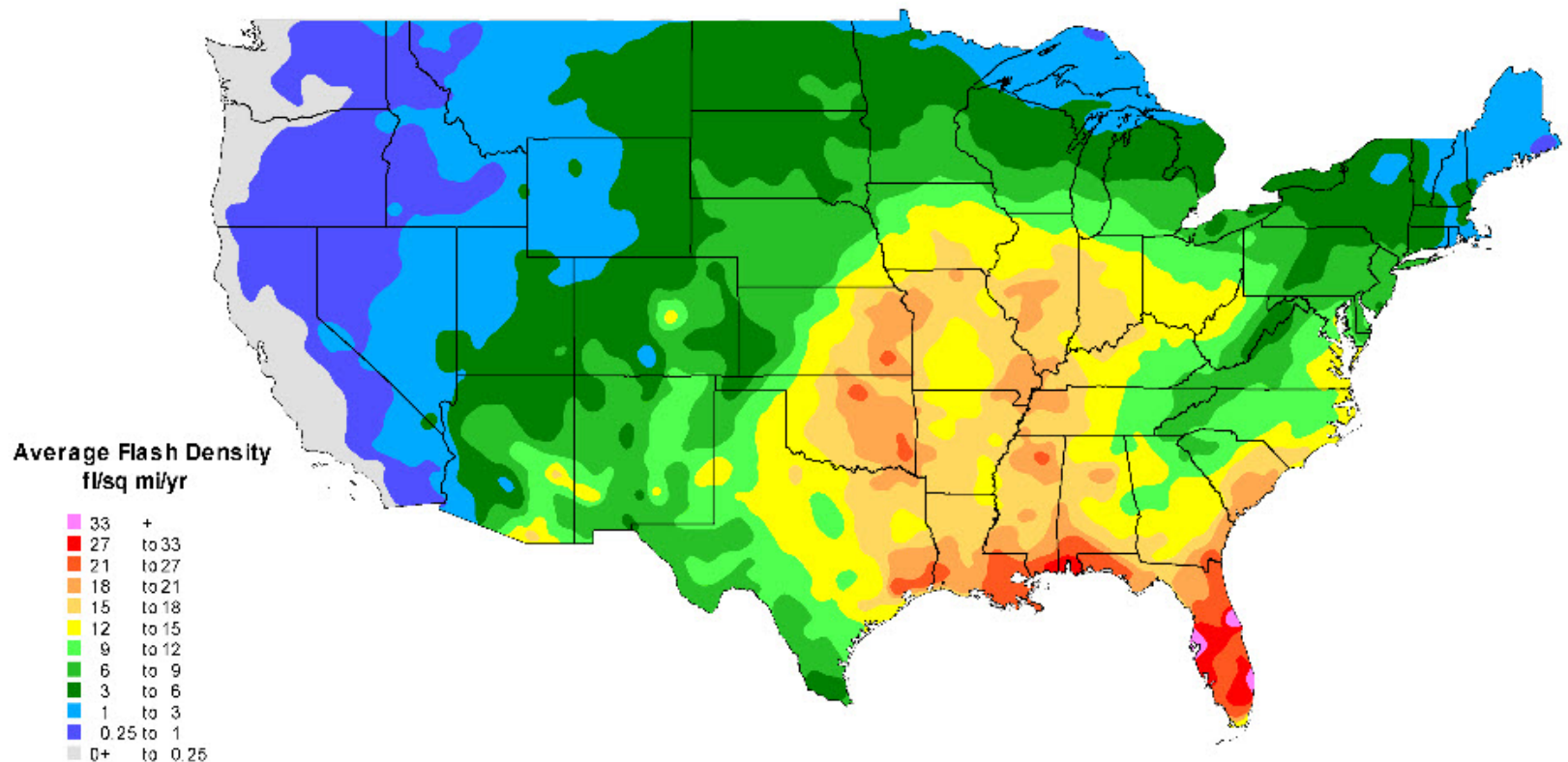
- Introduce the science and concepts of lightning
- Dispel the myths associated with lightning
- Provide examples supporting the underlying principles

# Lightning Across the United States

Source: U.S. Weather Service

# Vaisala's National Lightning Detection Network® (NLDN®)

Cloud-to-Ground Lightning Incidence in the Continental U.S. (1997 - 2012)



**VAISALA**

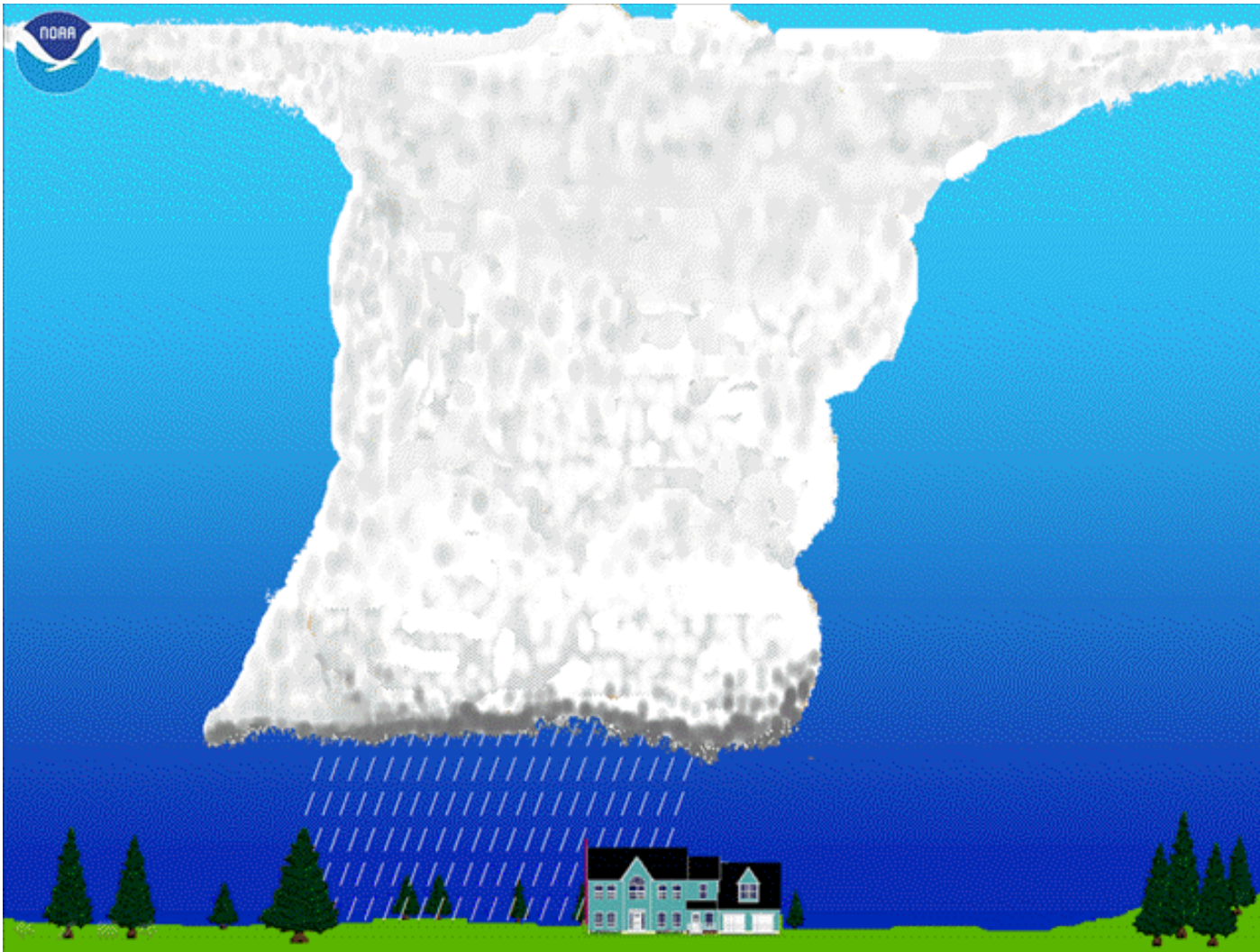
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**This map shows the average number of lightning strikes across the United States. Although Florida, the Gulf Coast, and the central U.S. see the most lightning, lightning can occur anywhere.**

# A Threat In All Seasons



# **What Is Lightning?**



**Lightning is a giant spark discharge of electricity within the cloud or between the cloud and the ground.**

# NFPA 921 (2014 Edition)

## Pt. 9.12.8.3 - Lightning Strikes.

- Lightning tends to strike the tallest object on the ground in the path of its discharge. Lightning enters structures in four ways:
- (1) By striking a metallic object like a TV antenna, a cupola, or an air-conditioning unit extending up and out from the building roof
- (2) By directly striking the structure
- (3) By hitting a nearby tree or other tall structure and moving horizontally to the building
- (4) By striking nearby overhead conductors and by being conducted into buildings along the normal power lines

# **What are the Common Myths?**

# MYTH #1

**Myth:** If you're caught outside during a thunderstorm, you should crouch down to reduce your risk of being struck.

**Fact:** Crouching doesn't make you any safer outdoors. are NOT safe anywhere outdoors.

# MYTH #2

**Myth:** Lightning never strikes the same place twice.

**Fact:** Lightning often strikes the same place repeatedly, especially if it's a tall, pointy, isolated object. The Empire State Building is hit nearly 100 times a year.

# MYTH #3

**Myth:** If it's not raining or there aren't clouds overhead, you're safe from lightning.

**Fact:** Lightning often strikes more than three miles from the center of the thunderstorm, far outside the rain or thunderstorm cloud and can strike 10-15 miles from the thunderstorm.

# MYTH #4

**Myth:** Rubber tires on a car protect you from lightning by insulating you from the ground.

**Fact:** Most cars are safe from lightning, but it is the metal roof and metal sides that protect you, NOT the rubber tires. Don't lean on doors during a thunderstorm.

# MYTH #5

**Myth:** A lightning victim is electrified. If you touch them, you'll be electrocuted.

**Fact:** The human body does not store electricity. It is perfectly safe to touch a lightning victim to give them first aid.

# MYTH #6

**Myth:** If outside in a thunderstorm, you should seek shelter under a tree to stay dry.

**Fact:** Being underneath a tree is the second leading cause of lightning casualties. Better to get wet than fried!

# MYTH #7

**Myth:** If you are in a house, you are 100% safe from lightning.

**Fact:** A house is a safe place to be during a thunderstorm as long as you avoid anything that conducts electricity.

# MYTH #8

**Myth:** If thunderstorms threaten while you are outside playing a game, it is okay to finish it before seeking shelter.

**Fact:** Many lightning casualties occur because people do not seek shelter soon enough. Adults are responsible for the safety of children.

# MYTH #9

**Myth:** Structures with metal, or metal on the body (jewelry, cell phones, watches, etc.) will attract lightning.

**Fact:** Height, pointy shape, and isolation are the dominant factors controlling where a lightning bolt will strike. The presence of metal makes absolutely no difference on where lightning strikes.

# MYTH #10

**Myth:** If trapped outside and lightning is about to strike, I should lie flat on the ground.

**Fact:** Lying flat increases your chance of being affected by potentially deadly ground current. If you are caught outside in a thunderstorm, keep moving toward a safe shelter.

# MYTH #11

**Myth:** lightning flashes are 3-4 km apart

**Fact:** Old data said successive flashes were on the order of 3-4 km apart. New data shows half the flashes are about 9 km apart. In the past, 3 to 5 km (2-3 miles) was as used in lightning safety education.

# MYTH #12

**Myth:** A High Percentage of Lightning Flashes Are Forked.

**Fact:** Many cloud-to-ground lightning flashes have forked or multiple attachment points to earth. Tests carried out in the US and Japan verify this finding in at least half of negative flashes and more than 70% of positive flashes.

# MYTH #13

**Myth:** Lightning Can Spread out Some 60 Feet After Striking Earth.

**Fact:** Radial horizontal arcing has been measured at least 20 m. from the point where lightning hits ground. Depending on soils characteristics, safe conditions for people and equipment near lightning termination points (ground rods) may need to be re-evaluated.

# **The Lightning Flash**

**The most common cloud-to-ground lightning flash\* consists of:**

- 1. A stepped leader**
- 2. A return stroke**
- 3. Dart leader(s)**
- 4. Return stroke(s)**

**Now we'll take a look at the science of the lightning flash.**

**\* The most common cloud-to-ground lightning flash is the “negative” cloud-to-ground flash.**

# **How Do I Tell How Far Away The Lightning Is?**

**If you count the number of seconds between the flash of lightning and the sound of thunder, and then divide by 5, you'll get the distance in miles to the lightning.**

**30 seconds = 6 miles**

**15 seconds = 3 miles**

**5 seconds = 1 mile**

**0 seconds = very close**

**Be sure you are in a safe place while counting! If you can hear thunder, chances are that you're within striking distance of the storm.**

# “Heat Lightning”



Normally, you can hear thunder if you're less than 10 miles from a lightning strike. For storms more than 10 miles away, although you may see flashes of light, you're probably too far away to hear the thunder. Many people call this “heat lightning,” but, in reality, it's just normal lightning from a distant thunderstorm. In many cases, the light you see is being reflected off high clouds near the storm.

# Lightning Safety

There are a few simple guidelines that can keep you safe from lightning. Lightning can strike 10 miles from a thunderstorm which is about the distance that you can hear thunder. If you hear thunder, you're likely within striking distance of the storm.

- If you hear thunder, even a distant rumble, get to a safe place immediately.
- Remain in that safe place for 30 minutes after the last lightning or thunder.

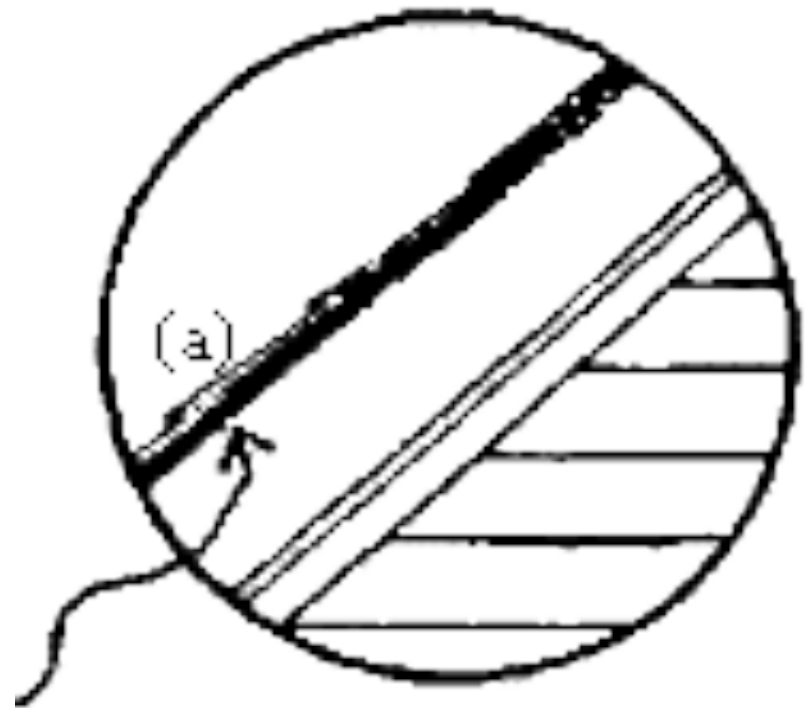
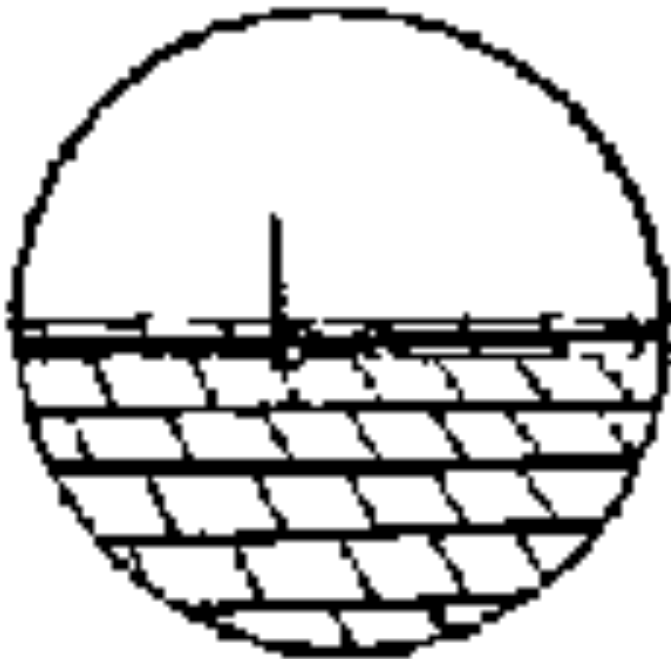
Proper planning may be needed for many summertime activities so that you can get to a safe place quickly. You don't want to get caught outside in a thunderstorm and not have a safe place to go.

# Lightning Protection

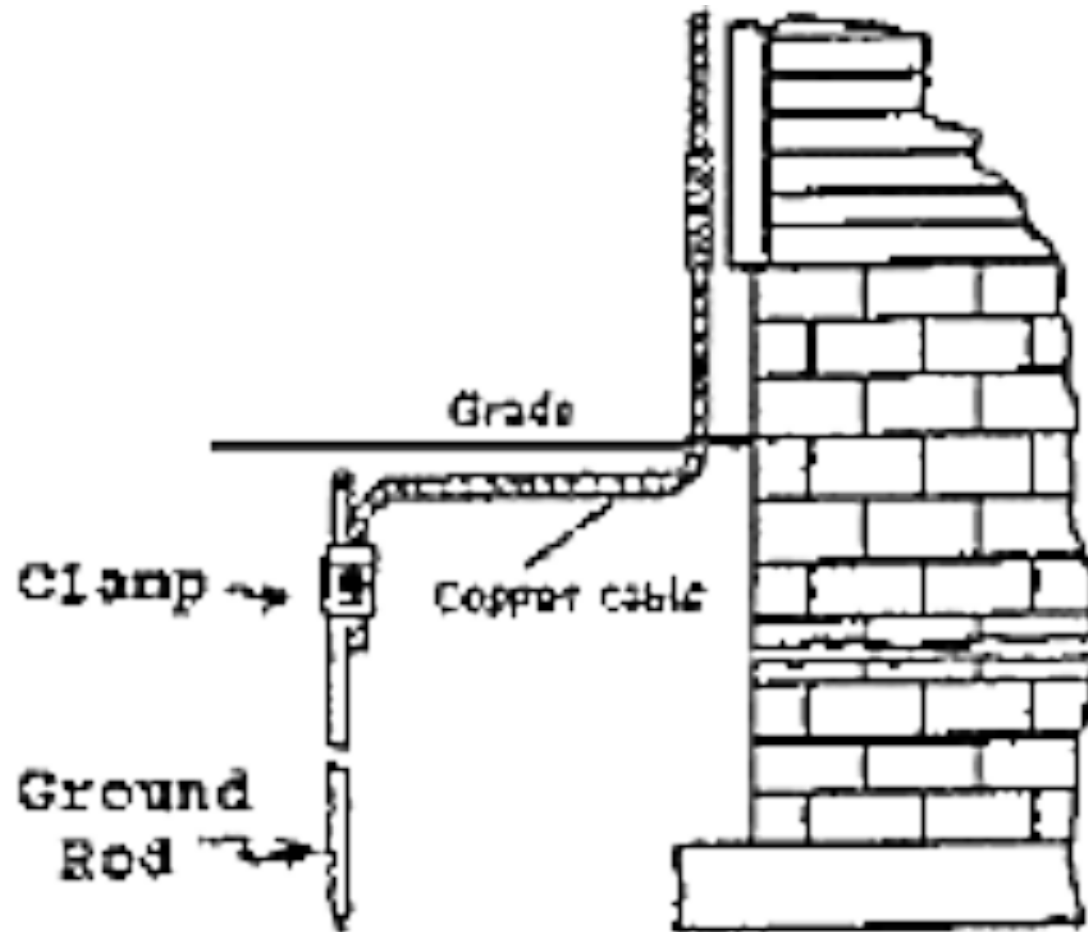
# Four Main Features of Lightning Protection

- 1) Air terminal
- 2) Conductors
- 3) Ground termination
- 4) Surge protection

# Air Terminal and Conductors



# Grounding Rod



A chimney wider than 4 feet requires 2 Rods - If chimney is less than 4 feet, only 1 Rod is required.

Use bonding lug to connect vent that is on roof within 6 ft. of the lightning rod wire. (if metal)

Rod on cupola

Rods to be 2 feet from end or less.

Cable

MAX. 20' APART

All bends in cable shall be gradual

Anchor cable to roof, sides and edges of building with LOOP HOLDERS every 3 ft. maximum

Space roof Rods evenly along the ridges - must not be more than 20' apart

Clamp

8 x 1/2 Ground Rod

Tee or Twin connector

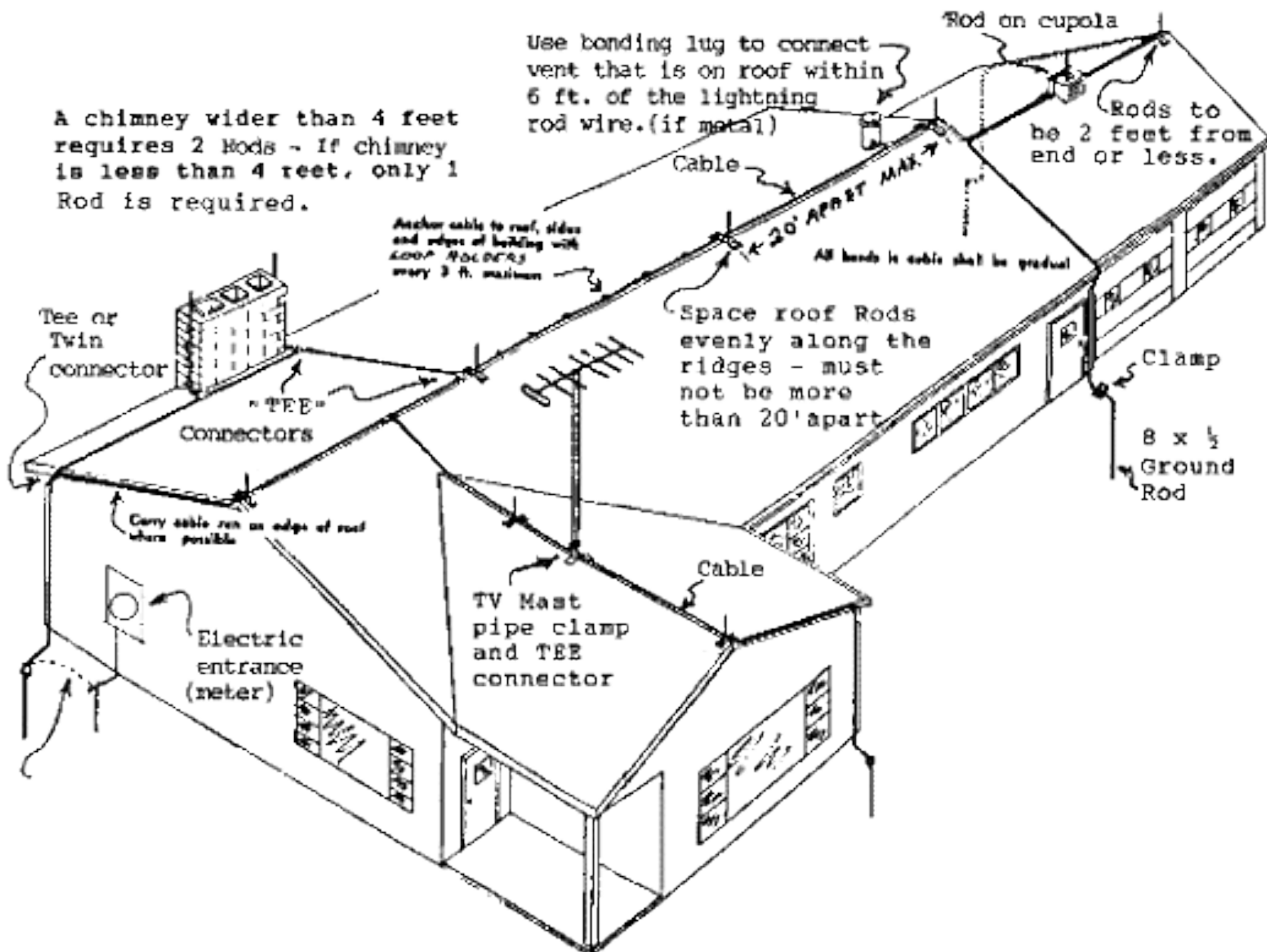
"TEE" Connectors

Carry cable run on edge of roof where possible

Electric entrance (meter)

TV Mast pipe clamp and TEE connector

Cable



# For More Information



National Weather Service

## Lightning Safety

www.nws.noaa.gov



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### Lightning Safety: *When Thunder Roars, Go Indoors!*

#### What's New?

- [NWS Lightning Safety Awareness Message](#)
- [Lightning Deaths in 2013](#)
- [The Dr Lightning Show: Intro, Victims, Science](#)
- [Latest Lightning Safety Blog](#)
- [Beyond Thunder Dumb: When Lightning Strikes](#)

Summer is the peak season for one of the nation's deadliest weather phenomena—lightning. Though lightning strike peak in summer, people are struck year round. In the United States, an average of 54 people are killed each year by lightning, and hundreds more are severely injured.



**Safety:** Learn what you need to do to stay safe when thunderstorms threaten.



**Victims:** Learn what happens to people who are struck by lightning and look at fatality statistics for the U.S.



**Science:** Learn how thunderstorms develop and what happens during a lightning discharge.



**Myths and Facts:** Get answers to many of the questions you have always wondered about



**More Resources:** Download toolkits, posters, pamphlets, and other information to help communities, organizations, and families stay safe from the dangers of lightning



**Teachers:** find curriculum guides, presentations games, activities, and more.  
**Kids:** Download games, videos, coloring pages and other fun stuff.

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[www.lightningsafety.noaa.gov](http://www.lightningsafety.noaa.gov)